ARL 01-37

REMARKS/ARGUMENTS

Claims 1-12 are pending in this Application. Claims 1-12 have bee Rejected under 35 U.S.C. §102 as being Anticipated by Kasamatsu, *et al.* (20030096168).

Rejection of Claims under 35 U.S.C. § 102:

The Examiner has Rejected Claims 1-12 as Anticipated by Kasamatsu, *et al.* (20030096168) stating:

> A person shall be entitled to a patent unless —
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

General Response.

Applicant respectfully disagrees with the Examiner that Kasamatsu, *et al.* (20030096168) Anticipates Applicant's Invention. Applicant was aware of the Kasamatsu, *et al.* Application and, as the Examiner knows, cited this Application on the Information Disclosure Statement submitted by Applicant along with a Preliminary Amendment to correct a Drawing error on 24 October 2003. Kasamatsu, *et al.* is relevant prior art; however, it just does not describe Applicant's Invention. In the first instance this is one of those cases where the Preamble to the Claim is relevant. Claim 1 Claims "an electrolyte for a metal-oxygen battery ..." and claims 2 through 6 either directly or indirectly Depend from Claim 1 and Claim the Electrolyte of Claim 1, i.e., "an electrolyte for a metal-oxygen battery." Claim 7 Claims a "metal-oxygen battery" containing the electrolyte described in Claim 1 and claim 8 depends from Claim 7. Claim 9 Claims a "method for optimizing the composition of an electrolyte for a metal-oxygen battery," and Claim 10 Depends from Claim 9.

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It is true that the preamble of a claim does not limit the scope of the claim when it merely states a purpose or intended use of the invention. See ***In Re Paulsen,*** 30 F.3d 1475, 1478-79, 31 USPQ2d 1671, 1673 (Fed. Cir. 1994) citing *DeGeorge v. Bernier*, 768 F.2d 1318, 1322 n.3, 226 USPQ 758, 761 n.3 (Fed. Cir. 1985). There are situations; however, when terms appearing in a preamble may be deemed limitations of a claim because they "give meaning to the claim and properly define the invention." ***In Re Paulsen*** at 1479 citing *Gerber Garment Technology, Inc. v. Lectra Sys., Inc.*, 916 F.2d 683, 688, 16 USPQ2d 1436, 1441 (Fed. Cir. 1990) (quoting *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 896, 221 USPQ 669, 675 (Fed. Cir.), cert. denied, 469 U.S. 857, 83 L. Ed. 2d 120, 105 S. Ct. 187 (1984)). ***In Re Paulsen*** goes on to state that "although no 'litmus test' exists as to what effect should be accorded to words contained in a preamble, review of a patent in its entirety should be made to determine whether the inventors intended such language to represent an additional structural limitation or mere introductory language. Citing *Corning Glass Works v. Sumitomo Elec. U.S.A., Inc.*, 868 F.2d 1251, 1257, 9 USPQ2d 1962, 1966 (Fed. Cir. 1989); *In re Stencel*, 828 F.2d 751, 754, 4 USPQ2d 1071, 1073 (Fed. Cir. 1987). This is a situation such as ***In Re Paulsen***; whereas in that case the preamble dealt with "a computer," in this case Applicant is Claiming an electrolyte "for a metal-oxygen battery." A metal-oxygen battery is a specific type of battery.

The Kasamatsu, *et al.* Patent Application states in its title what it relates to: a "Non-Aqueous Electrolyte Secondary Battery." The Inventors use this term throughout the application (page 1, paragraph 0001, 0008, 0009, 0015, page 3, paragraph 0053, etc.). The term is defined on page 3, paragraph 0053 where Kasamatsu, *et al.* states

> "The non-aqueous electrolyte secondary battery in accordance with the present invention comprises an electrolyte, and a positive electrode capable of absorbing and desorbing lithium and the aforesaid negative electrode."

The Kasamatsu, *et al.* Patent Application has to do with the method of preparing the aforesaid negative electrode. Kasamatsu, *et al.* then goes on to say that the positive electrode is one of the common metal oxides (page 3, paragraph 0055) or a metal

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chalcogenide, uncommon metal oxide, conjugate polymer material, or a Chevrel phase material. Kasamatsu, *et al.* does not mention any soluble cathode materials as they are not generally found in secondary battery applications.

The metal-oxygen battery is distinguished from the Non-Aqueous Electrolyte Secondary Battery (also called a lithium-ion battery) by several factors. The first factor is that the metal-oxygen battery uses a soluble cathode material, *i.e.* O_2 that needs to be transported through the bulk of a carbon black electrode that acts as a current collector for the cathode reaction (cathode reaction: $O_2 + 2e^- \rightarrow O_2^{-2}$). The lithium-ion battery, as well as other lithium primary batteries, already have the cathode material in place with no transport being necessary. The metal-oxygen battery functions properly only when the O_2 can be transported into the cell through the electrolyte in a quick and efficient manner. It is the ability of the electrolyte to transport the O_2 that is of most importance and is what distinguishes a lithium-oxygen battery electrolyte from a lithium-ion battery electrolyte.

The second factor that distinguishes a metal-oxygen battery from a lithium-ion battery is that the discharge product ($2Li^+ + O_2^{-2} \rightarrow Li_2O_2$) is deposited in the cathode as a solid and discharge ends when the carbon black electrode is full of Li_2O_2. Discharge in a lithium-ion battery ceases when all of the lithium in the anode is shuttled over to the cathode.

A person skilled in the art of batteries would not know from the Kasamatsu, *et al.* work or any other published work how to identify or make a useful and practical electrolyte for a metal-oxygen battery. There is no information in Kasamatsu, *et al.* on oxygen solubility, viscosity, or stability towards O_2 and O_2^{-2}. In fact, neither the word "oxygen" nor the term "solubility" even appear anywhere in the Kasamatsu, *et al.* Patent Application.

Thus, Kasamatsu, *et al.* even in "disclosing" a "non-aqueous electrolyte" is disclosing an electrolyte for a secondary or lithium-ion battery and not an "electrolyte for a metal-oxygen battery" as specifically Claimed in the present Application.

Specifically

The Examiner states that:

> As to claim 1, Kasamatsu et al. discloses an electrolyte for a metal oxygen battery, the electrolyte comprising a non-aqueous solvent being characterized in that the solubility of oxygen therein is at least 0.1150 ccO2/cc solvent at STP, and a metal electrolyte salt dissolved in the solvent (pg 4 paragraphs 0069,0071).

Response

A person of ordinary skill in the art could not conclude from paragraphs 0069 and 0071 that the solubility is at least 0.1150cc O_2/cc electrolyte. Of the electrolytes listed, most will not have this solubility, a few will. Most of the solvents themselves will not have solubility's of 0.1760 ccO_2/cc solvent.

In fact, Kasamatsu, *et al.* merely provides a laundry list of non-aqueous solvents:

> [0069] The non-aqueous electrolyte used in the present invention comprises a solvent and a lithium salt dissolved in the solvent. As for the non-aqueous solvent, there are, for example, cyclic carbonates such as ethylene carbonate (EC), propylene carbonate (PC), butylene carbonate (BC) and vinylene carbonate (VC), chain carbonates such as dimethyl carbonate (DMC), diethyl carbonate (DEC), ethyl-methyl carbonate (EMC) and dipropyl carbonate (DPC), aliphatic carboxylic acid esters such as methyl formate, methyl acetate, methyl propionate and ethyl propionate, .gamma.-lactones such as .gamma.-butyrolactone, chain ethers such as 1,2-dimethoxy ethane (DME), 1,2-diethoxy ethane (DEE) and ethoxy-methoxy ethane (EME), cyclic ethers such as tetrahydrofuran and 2-methyl tetrahydrofuran, and they can be used singly or in an arbitrary combination of one or more.

In regard to Kasamatsu, *et al.*'s laundry list, whether all of these solvents will work for metal-oxygen batteries, Applicant's Inventor's answer is most will "work" but only to varying degrees. Some of the solvents are not stable with the metal anode (e.g. methyl acetate), some are not stable with the discharge product (DEC) and some have very low oxygen solubility (*e.g.*, EC) that leads to almost no discharge capacity

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in the metal-oxygen battery. Applicant's Inventor has published data as to which ones work better (PC and EC are poor) and which ones are better (DOL, DME). Hence, Kasamatsu, *et al.* is not an enabling document when it comes to the identification of solvents for use in the electrolyte of a metal-oxygen battery. Even if a person of skill in the art were to be motivated to try the solvents listed in a metal-oxygen battery, they would have no basis to decide which, if any, would be effective since Kasamatsu, *et al.* did not recognize the importance of oxygen solubility.

Applicant's invention is based on the fact that Abraham had disclosed in his Patent 5,510,209 that certain solvents should be used for the lithium-oxygen battery. Those solvents, he taught, should have high dielectric constants and high boiling points. Abraham indicated nothing about solubility. In fact, Applicant's invention Claims solvents at the other end of the spectrum (low dielectric constant and low boiling point) from those taught by Abraham because they lead to higher solubility for oxygen. The fact that Abraham teaches away from the selection of solvents identified by Applicants as effect solvents for an oxygen-metal battery underscores the difference between a non-aqueous electrolyte secondary battery (a lithium-ion battery) and an oxygen-metal battery as recited in the preamble to Applicant's Claims as discussed above.

The Examiner should be unable to find extensive reference material regarding this subject. There is very little reference material available for these types of measurements on battery electrolytes. Most of what is available in the area on both the solvents and electrolytes has been published by the Applicant's Inventor.

In short, restating Applicant's position in regard to Claim 1:
In Applicant's Patent Application at page 1, paragraph 0003, Applicant specifics the kind of battery for which the Invention is intended. That premise is repeated in the specific language of the Claims wherein the Claim is directed to "an electrolyte for a metal-oxygen battery." The recognition of the importance of oxygen solubility, which was never recognized by Kasamatsu, *et al.* was restated on page 3, paragraph

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0006 when Applicant states, "In accord with the present invention, it has been found that the solubility of oxygen in a solvent is the primary factor which must be considered when formulating electrolytes for metal-oxygen batteries."

The Examiner is incorrect to say that "As to claim 1, Kasamatsu, *et al.* discloses an electrolyte for a metal oxygen battery,..." The Patent Application by Kasamatsu, *et al.* does not disclose an electrolyte for a metal-oxygen battery but an electrolyte for "a non-aqueous electrolyte secondary battery comprising a negative electrode containing: a negative electrode material composed of a composite particle....." (page 1, paragraph 0009). This statement would generally be understood by a person working in this field to be a lithium-ion battery with an alloy anode material.

The Examiner is also incorrect to say that "As to claim 1, Karamatsu, et al. discloses ... the solubility of oxygen therein is at least 0.1150 ccO_2/cc solvent..." The Patent Application by Kasamatsu, *et al.* does not disclose anything about the particular properties of the electrolyte that might be important for the operation of his non-aqueous electrolyte secondary battery. Kasamatsu *et al.* on page 4, paragraph 0069) lists solvents and states that "they can be used singly or in an arbitrary combination of one or more." This would seem to indicate that Kasamatsu, *et al.* does not have any particular preference for one electrolyte solvent or another and gives no information on how to select an electrolyte solvent. It would be hard to see how a person "skilled in the art" of non-aqueous lithium-ion batteries could read the Kasamatsu application and anticipate that one electrolyte or another would be preferable for a metal-oxygen battery.

Specifically

The Examiner states that:

> As to claim 2, Kasamatsu et al. discloses that the solvent comprises a mixture of materials, and wherein at least 50% on a weight basis of the materials have an oxygen solubility of at least 0.1760 ccO2/cc at STP (pg 4 paragraphs 0069,0071).

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Response

The patent application by Kasamatsu, *et al.* does not disclose that the solvents used to prepare an electrolyte should be a mixture of materials, and wherein at least 50%, on a weight basis, of said materials have an oxygen solubility of at least 0.1760 cc O_2/cc at STP. Kasamatsu, *et al.* makes no statement or even implies that oxygen solubility is a factor for consideration in the preparation of an electrolyte for the non-aqueous electrolyte secondary battery. Applicant's Attorney has reproduced paragraph 0069 above. Paragraph 0071 is reproduced below in its entirety:

> [0071] As for the lithium salt dissolved in these solvents, there are, for example, $LiClO_4$, $LiBF_4$, $LiPF_6$, $LiAlCl_4$, $LiSbF_6$, LiSCN, LiCl, $LiCF_3SO_3$, $LiCF_3CO_3$, $Li(CF_3SO_2)_2$, LiAsF.sub.6, $LiN(CF_3SO_2)_2$, $LiB_{10}Cl_{10}$, lithium lower aliphatic carboxylate, LiCl, LiBr, LiI, chloroboranlithium, lithium tetraphenyl borate and imido, and they can be used singly or in an arbitrary combination of one or more. In particular, $LiPF_6$ is more preferably contained.

Note that there is no discussion of weight basis or oxygen solubility. In fact, since an "arbitrary combination" is suggested it would be highly unlikely that at least 50%, on a weight basis, of said materials have an oxygen solubility of at least 0.1760 cc O_2/cc at STP. In addition as recited above, since Claim 1 should be Allowable, Claim 2 Depending from an Allowable Claim (Claim 1) should also be Allowable.

Specifically

The Examiner states that:

> As to claim 3, Kasamatsu et al. discloses that the nonaqueous solvent comprises diethyl carbonate (pg 4 paragraphs 0069).

Response

As recited above, since Claim 1 should be Allowable, Claim 3, Depending from an Allowable Claim (Claim 1), should also be Allowable. Applicant's Attorney notes that if necessary this Claim could be Amended to delete the non-aqueous solvents that are listed in Kasamatsu, *et al.*

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Specifically

The Examiner states that:

> As to claim 4, Kasamatsu et al. discloses that the metal oxygen battery is a lithium battery and wherein the metal elcctrolyte salt is a lithium salt (pg 4 paragraph.

Response

As described above, Kasamatsu, *et al.* does not disclose a metal-oxygen battery. In addition, since Claim 1 should be Allowable, Claim 4, Depending from an Allowable Claim (Claim 1), should also be Allowable.

Specifically

The Examiner states that:

> As to claim 5, Kasamatsu et al. discloses that the lithium salt is LiPF6 (pg 4 paragraph 0071).

Response

As recited above, since Claim 1 should be Allowable, Claim 5, Depending from an Allowable Claim (Claim 4), should also be Allowable. Applicant's Attorney notes that if necessary this Claim could be Amended to delete the non-aqueous solvents that are listed in Kasamatsu, *et al.*

Specifically

The Examiner states that:

> As to claim 6, Kasamatsu et al. discloses that the metal electrolyte salt is in the range of 0.5-1.0 molar (page 5 paragraph 0096).

Response

As recited above, since Claim 1 should be Allowable, Claim 6, Depending from an Allowable Claim (Claim 1), should also be Allowable. Applicant's Attorney notes that if necessary this Claim could be Amended to limit the range to < 1.0 molar.

Specifically

The Examiner states that:

> As to claim 7, Kasamatsu et al. discloses a metal oxygen battery comprising a metal containing anode (page 3 paragraph 0049), an electro-active oxygen cathode (page 3 paragraph 0055), an electrolyte disposed so as

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> to provide ionic communication between the anode and the cathode (page 2 paragraph 0026), the electrolyte comprising a non aqueous solvent, the solvent characterized in that the solubility of oxygen therein is at least 0.1150 cco2.cc at STP and a metal electrolyte salt dissolved in the solvent (pg 4 paragraphs 0069,0071).

Response

As described above, Kasamatsu, *et al.* does not disclose a metal-oxygen battery. In addition, page 3, paragraph 0055 does not disclose an electro-active oxygen cathode. but lists metal oxide cathodes typically used in lithium-ion batteries. Metal oxides when used as lithium-ion cathodes contain oxygen in the O^{-2} state (i.e. already reduced). In Applicant's Invention molecular oxygen (O_2) is reduced to O_2^{-2} or O^{-2} in the cathode reaction.

> [0055] As for the positive electrode material of the present invention, a lithium-contained compound or a lithium-free compound may be employed, and, for example, Li_xCoO_2, Li_xNiO_x, Li_xMnO_x, $Li_xCo_yNi_{1-y}O_x$, $Li_xCo_yM_{1-y}O_z$ $Li_xNi_{1-y}M_yO_z$, $Li_xMn_2O_4$, $Li_xMn_{2-y}M_yO_4$(M is at least one selected from the group consisting of Na, Mg, Sc, Y, Mn, Fe, Co, Ni, Cu, Zn, Al, Cr, Pb, Sb and B, x=0 to 1.2, y=0 to 0.9, z=2.0 to 2.3), and the like, can be cited.

Moreover, as noted above, neither paragraph 0069 nor 0071 discuss weight basis or a solubility of oxygen therein that is at least 0.1150 cc O_2/cc at STP. Applicant's Attorney notes that paragraph 0026 does not appear to mention an electrolyte; perhaps the Examiner meant another paragraph. This Claim is not Anticipated by Kasamatsu, *et al.* and should be Allowed.

Specifically

The Examiner states that:

> As to claim 8, Kasamatsu et al. discloses wherein the nonaqueous solvent comprises a plurality of components, and wherein the oxygen solubility of at least 50% of the components on a weight bases is at least 0.1760cc 02/cc at SlP (pg 4 paragraphs 0069, 0071).

Response

As described above, Kasamatsu, *et al.* does not disclose a metal-oxygen battery. In addition, there is no discussion of weight basis or oxygen solubility in paragraphs 0069 and 0071 as described above. In fact, since an "arbitrary combination" is suggested it would be highly unlikely that wherein at least 50%, on a weight basis, of said materials have an oxygen solubility of at least 0.1760 cc O_2/cc at STP. This

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Claim is not Anticipated by Kasamatsu, *et al.* and should be Allowed. Moreover, since Claim 7 should be Allowable, Claim 8, Depending from an Allowable Claim (Claim 7), should also be Allowable.

Specifically

The Examiner states that:

> As to claim 9, Kasamatsu et al. discloses a method for optimizing the composition of an electrolyte for a metal oxygen battery, the electrolyte comprising a solvent and an electrolyte salt, the method comprising the step of selecting the solvent from those materials which will dissolve the electrolyte salt and which have a solubility for oxygen which is at least 0.1150cc 02/cc at SIP (p94 paragraphs 0069,0071).

Response

As described above, Kasamatsu, *et al.* does not disclose a metal-oxygen battery; therefore, it does not disclose a method for optimizing the composition of an electrolyte for a metal-oxygen battery. Kasamatsu, *et al.* makes no statement or even implies that oxygen solubility is a factor for consideration in the preparation of an electrolyte for the non-aqueous electrolyte secondary battery. Kasamatsu, *et al.* also gives no method for optimizing the composition of an electrolyte for a metal-oxygen battery. Nor is a solubility for oxygen of at least 0.1150 cc O_2/cc at STP mentioned or implied. This Claim is not Anticipated by Kasamatsu, *et al.* and should be Allowed.

Specifically

The Examiner states that:

> As to claim 10, Kasamatsu et al. discloses wherein the solvent is selected from materials comprising a mixture of components in which at least 50% of the components on a weight basis have a solubility for oxygen which is at least 0.1760cc 02/cc at SIP (pg 4 paragraphs 0069,0071).

Response

As described above, the Patent Application by Kasamatsu, *et al.* does not disclose that the solvents used to prepare an electrolyte should be a mixture of materials, and wherein at least 50%, on a weight basis, of said materials have an oxygen solubility of at least 0.1760 cc O_2/cc at STP. Kasamatsu *et al.* makes no statement or even

implies that oxygen solubility is a factor for consideration in the preparation of an electrolyte for the non-aqueous electrolyte secondary battery. In fact, since an "arbitrary combination" is suggested, it would be highly unlikely that at least 50%, on a weight basis, of said materials have an oxygen solubility of at least 0.1760 cc O_2/cc at STP. In addition as recited above, since Claim 9 should be Allowable, Claim 10, Depending from an Allowable Claim (Claim 9), should also be Allowable.

Specifically

The Examiner states that:

> As to claim 11, Kasamatsu et al. discloses an electrolyte for a lithium oxygen battery, the elctroyte [sic] comprising on a weight basis; I part of a first component of propylene carbonate and at least one part of a second component of diethyl carbonate and 0.5-1.0 moles of lithum [sic] electrolyte salt (pg 4 paragraphs 0069,0071).

Response

As Applicant's Attorney has noted above, Kasamatsu, *et al.* does not disclose an electrolyte for a metal-oxygen battery but rather for a non-aqueous electrolyte secondary battery (i.e., a lithium-ion battery) and it likewise does not disclose an electrolyte for a lithium-oxygen battery. Nor does Kasamatsu, *et al.* disclose an electrolyte ratio of one part of a non-aqueous solvent and at least one part of a second non-aqueous solvent and 0.5-1.0 moles of a lithium electrolyte salt. Kasamatsu, *et al.* suggests that the solvents can be used singly or in any arbitrary combination of one or more. Applicant's Attorney notes that if necessary, this Claim could be Amended to limit the range to < 1.0 molar lithium electrolyte salt.

Specifically

The Examiner states that:

> As to claim 12, Kasamatsu et al. discloses that the electrolyte salt comprises LiPF6 (pg 4 paragraphs 0069,0071).

Response

Once again, Applicant notes that Claim 12 Depends from Claim 11; therefore, the electrolyte in question is an electrolyte for a lithium-oxygen battery. Kasamatsu, *et*

al. does not disclose an electrolyte for a metal-oxygen battery but rather for a non-aqueous electrolyte secondary battery (i.e., a lithium-ion battery) and it likewise does not disclose an electrolyte for a lithium-oxygen battery. The use of the most common lithium-ion battery salt as a battery salt for a metal-oxygen *i.e.,* a lithium-oxygen battery is not anticipated by its use in a lithium-ion battery. Applicant's Attorney again repeats the introductory comments concerning the differences between the two types of batteries leading Applicant's Inventors to experiment contra to the existing art to develop and electrolyte based upon not high dielectric constants and high boiling points as taught but based upon oxygen solubility, viscosity or stability toward O_2 and O_2^{-2}. In addition, since Claim 12 Depends from Claim 11 and Claim 11 should be Allowable, Claim 12 should also be Allowable.

In view of the above explanation how a metal-oxygen battery differs from a non-aqueous electrolyte secondary battery, i.e., a lithium-ion battery, and argument supporting this distinction, Applicants submit that the references cited against the Claims does not teach or suggest the claimed Invention. Applicants recognized the distinction when they included the Kasamatsu, *et al.* Patent Application on the Information Disclosure Statement. Kasamatsu, *et al.* does not anticipate Applicant's Invention. Reconsideration of the rejections and allowance of the claims is respectfully requested. Should there remain any issues outstanding, the Examiner is invited to call the undersigned at his office telephone number set forth below.

Respectfully submitted,

17 OCTOBER 2005
DATE

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